Nanocomposites and nanomaterials

Creating suspension for tape casting of ferroelectric films with thickness less than five microns

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Known, that the threshold of film thickness obtained by tape casting with standard equipment limited by thickness of about 3-5 microns. In this work, we used special techniques for preparing suspensions, in which it is possible to obtain casting films with a thickness of less than 5 microns.

We used BaTiO3 powder with the size of 20 - 25 nm produced by "Nanotechcenter" company as a solid phase. The modification was carry out in a ball mill. A special type of surfactant was select for best result. Its amount was calculate to cover the surface of each particle by monomolecular layer after a destruction of agglomerates. Time and intensity of grinding also taken into account. An experimental mixture of PVB polymer with different molecular weight has been used us binder. These mixtures exhibited low viscosity and almost Newtonian flow. The polymer tapes casted from these mixtures were thin and solid. The optimum composition of the suspension is determine by the alternating change in the type and quantity of each component of the suspension. Suspension quality criteria are rheology and flow curve, film thickness and its roughness. By combining the obtained data, we were able to get the suspension formulation that is best for casting thin films. In order to optimize the process of preparation of the suspension were studied the impact of changing the order of addition of components of suspension. To powder was initially added plasticizer solution and then the polymer solution. The resulting slurry flow curves showed that changing the order of addition of components has reduced the viscosity of the system and changed the nature of the flow curve. Taking blade and the moving substrate for casting as two parallel plates, a shear rate acting on suspension was calculate for different heights of blade gap and at different speeds of substrate. Knowing shear rate and flow curve of suspension the viscosity and shear stresses acting on the suspension during passage through blade gap can be determinate. The nature of the flow that shows suspension passing the blade gap also can be predict.

Using these techniques where prepared a suspension and casted tapes with thickness of about 1.5 microns and roughness of about 17 nm even using simple equipment for casting (tape casting machine TTS-1200) and using conventional

ethanol as a solvent.